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The Benefits and Environmental Risks of Artificial Intelligence

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ABSTRACT

Artificial intelligence promises to increase output and productivity by an amount that surpasses any innovation since the onset of the Industrial Revolution. The ability to automate routine tasks, perform clerical and research functions, operate robots, and enhance and optimize physical, human, and virtual networks can free labor into alternative uses. Its ability to simulate chemical, pharmaceutical, and physical reactions can speed research and our understanding of the physical and biological worlds around us. However, this technology depends on the fabrication of sophisticated microchips and the employment of large data processing centers, each of which is resource-intensive. This paper analyzes the energy and environmental aspects of this promising technology within the construct of the monopolistic competition model and finds that our economy may be ill-prepared for the resource risks from artificial intelligence if its success mirrors what many prognosticators expect.

KEYWORDS

Artificial Intelligence, Energy, Monopolistic Competition, Resource Risk, Sustainability

1. INTRODUCTION

Few innovations since the onset of the Industrial Revolution have demonstrated the efficiencies and expansion of knowledge and productivity that many commentators and researchers expect from Artificial Intelligence (AI). Yet, while there is significant excitement and discussion about the potential for AI in areas of pure and applied science, medicine, engineering, many professions, and automation, these applications may not generate the most significant and immediate revenues as other more mundane commercial applications. This realization is important because both the investment (fixed or sunk costs) and the very high energy costs mandate AI applications that can cover these costs. In addition, the rather unusual nature of these costs not only dictates the types of applications most adept at funding AI, but they also dictate the ways in which competitors in the AI space interact with each other and the market. These circumstances give rise to resource risks that are rarely noted or analyzed. This paper describes AI innovations not from the perspective of their vast potentials, but from the implications on resources on a planet that is increasingly forced to come to terms with fossil fuel intensity and global warming.

In the first section of this paper, I define artificial intelligence and survey prognostications of its potential economic reach and various risks. I note that these various risks are incomplete, with little discussion on the implications on environment or energy markets. In section two, I describe the various facets of the production of artificial intelligence. In the third section, I motivate and apply the model of monopolistic competition to the processing of artificial intelligence models and categorize

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its implications in under-identified economic risks. In the fourth section, I discuss qualitatively the size of these risks and outline their future trends, given estimates described in the first section of the paper. I describe in section five recent efforts by governments, most notably the European Union, to prepare for these risks created by artificial intelligence, and formulate in section six alternative public policy avenues. I combine the discussions of artificial intelligence market penetration and the analysis of its market structure to discuss the long term market risks in section seven and I conclude in section eight..

2. DEFINITIONS OF ARTIFICIAL INTELLIGENCE

The polymath John von Neumann developed an important tool to aid in the modeling necessary for the Manhattan Project during World War II. His concept of an electronic device that could be reconfigured quickly to suit the needs of various problems was a revolutionary concept that forever changed humankind's relationship with machines. In parallel work, Alan Turing was developing an algorithmic approach to machine programing in his efforts to assist Britain's war effort in code-breaking. In 1950, he proposed the Turing Test. It states that we will know when a computer can successfully replicate important aspects of human mental capacity if a human can interact via a keyboard but not be able to determine whether they are conversing with a person or a machine. There is little doubt that humankind has long since passed that threshold for artificial intelligence.

The next threshold occurs when artificial intelligence becomes so successful that it replaces human effort and intervention in a wide variety of tasks. Computers have already replaced a large number of humans in labor-intensive activities such as customer support, proofreading, and similar activities, but is next poised to replace more creative processes such as writing, production of legal briefs, aspects of auditing, and any activity or simulation that requires significant data processing or thousands or billions of iterations or trial-and-error exercises.

The potential is astounding, as are the risks. Much of the effort to date has been in making the tools of artificial intelligence sufficiently accessible so they can broadly penetrate commercial, scientific, and creative markets. Now that humanity is well beyond the Turing Test threshold, such accessibility is largely complete. The next wave is in broadening the applications and deepening the penetration of AI.

Various authors have prognosticated about the extent that AI will replace labor. The estimates can be grouped into two camps. The first, for instance the AI research group SEO.AI (2024), estimates that 45 million American jobs may be lost to AI by 2030, while 145 million workers may require retraining. Worldwide, they report the potential for 800 million jobs to be affected by 2030, while AI will generate $18.7 trillion in additional economic activity. Similarly, Manyika et al (2017) predict that economic growth arising from AI will generate between 250 million and 280 million new jobs globally.

This first risk, of human substitution, potentially induces a feedback loop in the economy. Wealth continues to be created and grow, but it is concentrated in the hands of the few that control AI, support the factor needs of AI, or are in the best position to monetize the products of AI. This concentration of wealth can be reinvested into even greater profit possibilities, which merely grows the largest and most AI-adept corporations. This shift of earnings from displaced laborers to ever-wealthier shareholders reduces consumption because the wealthy consume a smaller fraction of their income on consumption. Western economies have witnessed such an increased concentration of wealth among such high wealth households with a proportionally lower share of consumption. Commentators note that this trend reduces long term growth potential and gives rise to risks associated with decreased economic justice.

Some employment risk may be mitigated or entirely overcome if the innovations of AI stimulate economic growth and thus create more avenues for the employment of humans. In a seminal paper, William Stanley Jevons (1865) authored "The Coal Question" that explored the long term economic